# TEST REPORT

**Report Number: 3134607LEX-002**
**Project Number: 3134607**

**Evaluation of the G800E0AUAL**
**Model Number: G800E0AUAL**
**FCC ID: LHJGEN80CT**
**Industry Canada ID: 2807E-GEN80CT**

**FCC Part 15 Subpart C (15.247)**
**ICES-003 and RSS-210 Issue 5**

**For**

**Continental Automotive Systems**

| Test Performed by: | Test Authorized by: |
|---|---|
| Intertek | Continental Automotive Systems |
| 731 Enterprise Drive | 21440 West Lake Cook Road |
| Lexington, KY 40510 | Deer Park, IL 60010 |

**Prepared By:**______________________ **Date:**____10/15/2007________

Bryan C. Taylor, EMC Team Leader

**Approved By:**______________________ **Date:**____10/15/2007_________

Jason Centers, Senior Project Engineer



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# 1 JOB DESCRIPTION

## 1.1 Company Information

| Company Information | |
|---|---|
| **Manufacturer:** | Continental Automotive Systems |
| **Address:** | 21440 West Lake Cook Road<br>Deer Park IL 60010 |
| **Contact Name:** | James Zhang |
| **Telephone Number:** | (847) 862-1264 |

## 1.2 Test Sample Information

The G800E0AUAL is an in-vehicle OnStar system.

| Test sample | | | | |
|---|---|---|---|---|
| **Model Number:** | G800E0AUAL | | | |
| **Serial Number:** | Test Sample 1 | | | |
| **FCC ID:** | LHJGEN80CT | | | |
| **ICID:** | 2807E-GEN80CT | | | |
| **Device Category:** | Mobile | | | |
| **RF Exposure Category:** | General Population/Uncontrolled Environment | | | |
| **Transmission Modes:** | **Bluetooth** | **AMPS** | **CDMA Cell** | **CDMA PCS** |
| **Frequency Range, MHz:** | 2402MHz – 2480MHz | 824MHz - 849MHz | 824MHz - 849MHz | 1850MHz – 1910MHz |
| **Maximum Conducted RF Output Power:** | 3.14dBm | 27.6dBm | 24.91dBm | 25.67dBm |
| **Antenna Type:** | Not Supplied | Not Supplied | Not Supplied | Not Supplied |
| **Antenna Location:** | Externally Mounted | Externally Mounted | Externally Mounted | Externally Mounted |

## 1.3 System Support Equipment

Table 1-1 contains the details of the support equipment associated with the Equipment Under Test during the testing.

Table 1-1: System Support Equipment

| Description | Manufacturer | Model Number | Serial Number |
|---|---|---|---|
| Laptop | Compaq | EVO N410c | 3902A783 |
| Power Supply | Hewlett Packard | 6226B | 6M0366 |

## 1.4 Cables Used During Testing

Table 1-2 contains the details of the cables used during the testing.

Table 1-2: Interconnecting Cables Used During Testing

| Cables | | | | | |
|---|---|---|---|---|---|
| Description | Length | Shielding | Ferrites | Connection | |
| | | | | From | To |
| Multi-Conductor Wiring Harness (Data/Audio) | 2 ft | None | None | EUT | Test Interface Box |
| DC Power | 3 ft | None | None | Test Interface Box | DC Power Supply |
| RS232 Signal | 4 ft | Yes | None | Test Interface Box | Laptop |
| CDMA Antenna Cable | 6 ft | Yes | None | CDMA Antenna Port | CDMA Antenna |

### 1.5 System Block Diagram(s)

The diagrams below detail the interconnection of the EUT and its accessories during the testing.

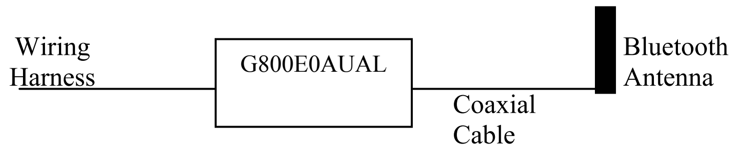
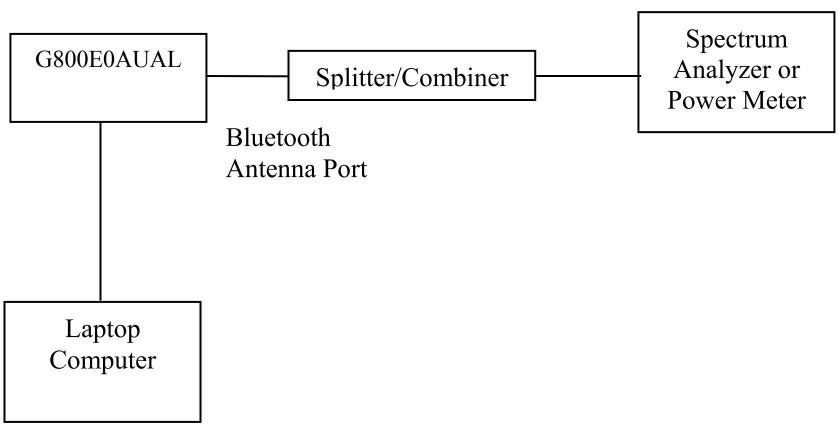



Figure 1-1: Radiated Test Configuration

Figure 1-2: Conducted Test Configuration




### 1.6 Mode(s) of operation / Engineering Judgments

The G800E0AUAL was powered by a 13VDC laboratory power supply.

For radiated testing, the Bluetooth antenna was connected to the G800E0AUAL. For conducted measurements the antenna was removed and a calibrated coaxial cable inserted between the Bluetooth port and the measuring equipment (spectrum analyzer or power meter). A base station simulator was used to force the G800E0AUAL to transmit at maximum output power.

# 2 EXECUTIVE SUMMARY

Testing performed for: Continental Automotive Systems

Equipment Under Test: G800E0AUAL

Receipt of Test Sample: 9/4/2007

Test Start Date: 9/5/2007

Test End Date: 9/18/2007

| DESCRIPTION OF TEST | RESULT | PAGE |
|---|---|---|
| Carrier Frequency Separation | **Compliant** | 9 |
| Number of Hopping Frequencies | **Compliant** | 11 |
| Time of Occupancy (Dwell Time) | **Compliant** | 13 |
| 20dB Bandwidth | **Compliant** | 17 |
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## 2.1 Modifications required for compliance

No modifications were implemented by Intertek. All results in this report pertain to the un-modified sample provided to Intertek.

## 3 TEST FACILITY

All testing was completed at the INTERTEK-Lexington location at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1: 1993 and ANSI C63.4: 1992. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

For radiated immunity testing, removable ferrite tiles are positioned between the transmitting antenna and the area occupied by the equipment under test. The remaining tests typically are performed outside the chamber on the conducting ground reference plane.

The Industry Canada filing number for this site is 2055A-1. The FCC registration number is 485103.

### 3.1 Test Equipment

| Description | Manufacturer | Model Number | Serial Number | Calibration due date |
|---|---|---|---|---|
| Environmental Chamber | Thermotron | SM-8C | 32692 | 1/24/2008 |
| Signal Generator | HP | 83620B | 3614A00199 | 8/20/2008 |
| Horn Antenna | EMCO | 3115 | 6556 | 8/2/2008 |
| Horn Antenna | Antenna Research | DRG-118/A | 1086 | 7/20/2008 |
| EMI Receiver | Rohde & Schwarz | ESI 40 | 1088.7490 | 5/9/2008 |
| Bilog Antenna | EMCO | 3142C | 00051864 | 11/14/2007 |
| Preamplifier | Miteq | AFS44-00102000-30-10P-44 | 987410 | 6/19/2008 |
| Digital Multimeter | Fluke | 87 | 1280 | 3/18/2008 |
| Base Station Simulator | Rhode & Schwarz | CMU200 | 1100.0008.02 | 3/29/2008 |
| Base Station Simulator | HP | 8920B | US37423763 | 3/13/2008 |
| Function Generator | HP | 3325B | 2801A0216 | 2/21/2008 |
| Modulator Analyzer | HP | 8901B | 2142A01663 | 3/22/2008 |

# 4 CARRIER FREQUENCY SEPARATION

## 4.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture two adjacent channels

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the marker-delta function was used to determine the separation between the peaks of the adjacent channels.

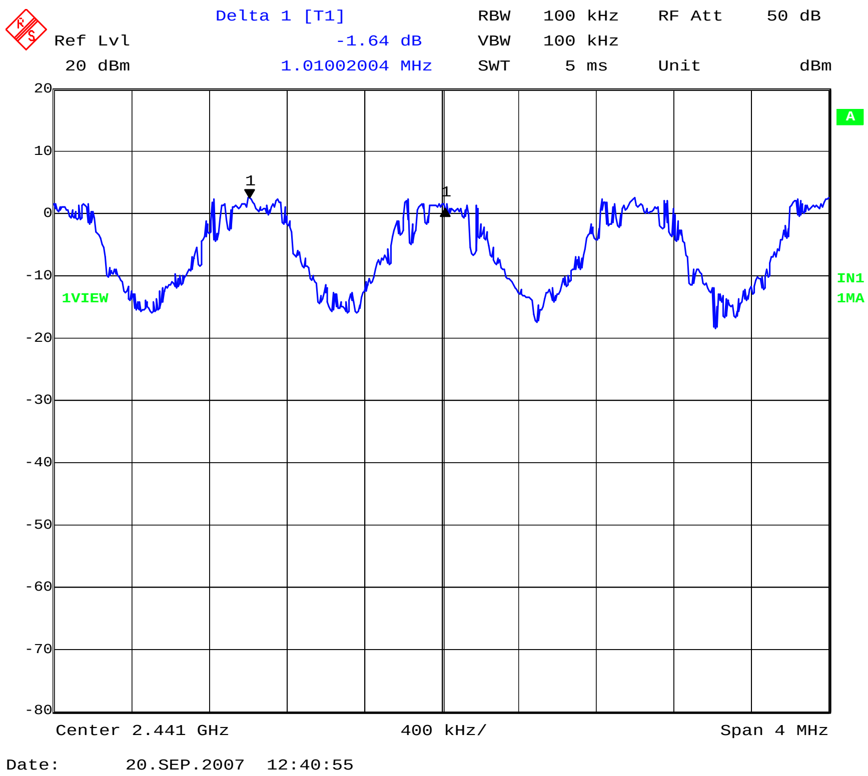
## 4.2 Limits

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

### 4.3 Test Results

The graph below illustrates that the carrier frequency separation is 1 MHz.

Figure 3: Carrier Frequency Separation



# 5 NUMBER OF HOPPING FREQUENCIES

## 5.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture two adjacent channels

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the number of hopping frequencies was counted.

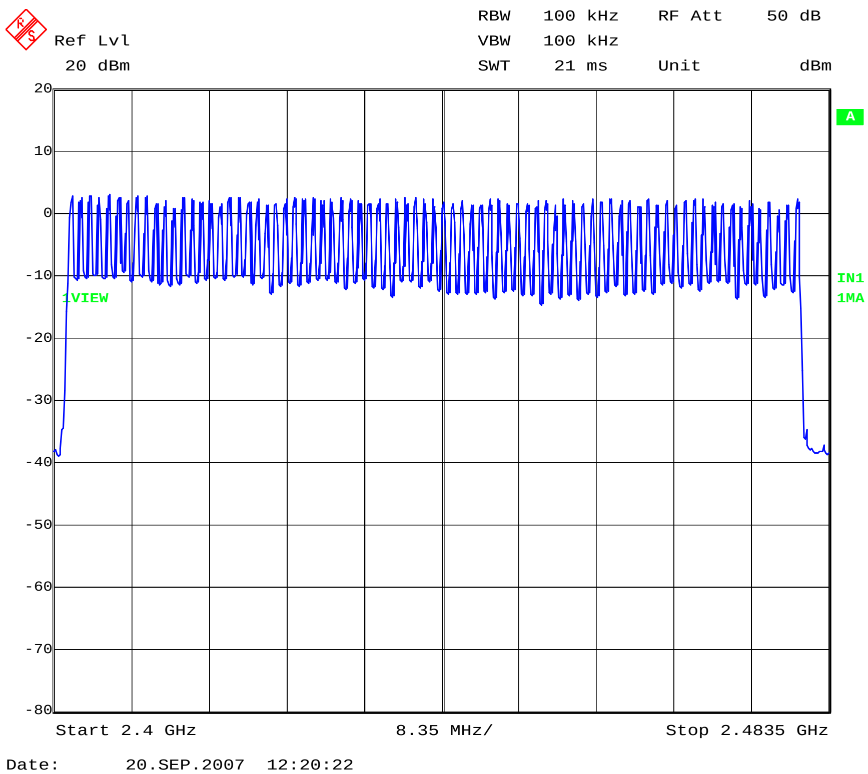
## 5.2 Limits

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels.

## 5.3 Test Results

The graph below illustrates that the number of hopping frequencies is 79.

Figure 4: Number of Hopping Frequencies



# 6 TIME OF OCCUPANCY (DWELL TIME)

## 6.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = Zero span centered on a hopping channel

RBW =1MHz

VBW ≥1MHz

Analyzer Mode = Video triggering mode

Sweep Time = Appropriate time to capture a complete dwell cycle

Detector Function = Peak

A complete dwell cycle was captured on the analyzer display. The marker delta function was used to determine the time of occupancy (dwell time).

## 6.2 Limits

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

## 6.3 Test Results

In the previous section, the number of hopping frequencies was shown to be 79. Therefore, the limit for the dwell time is 0.4Sec within a period of 31.6Sec (obtained from 0.4Sec*79=31.6Sec).

The graphs below illustrate a maximum "on time" of each pulse to be 525uS. They also show that 101 pulses occur within a 10S observation period. Therefore the average dwell time over a 31.6S period is:

0.000525Sec * (101pulses/10Sec) * (31.65Sec) = **0.167Sec**

Figure 5: Time of Occupancy (Dwell Time)

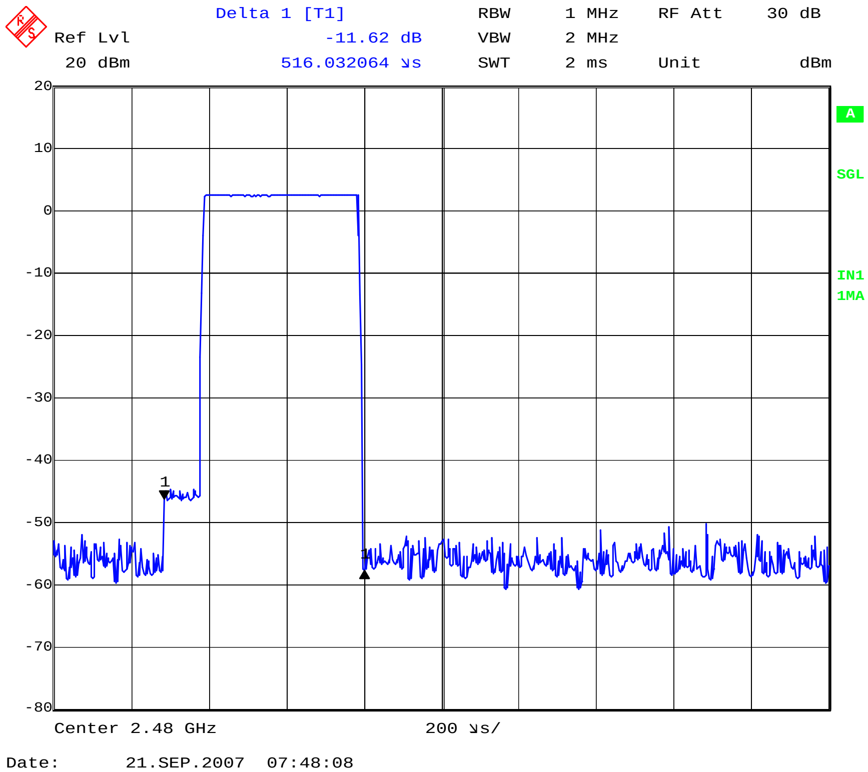



Figure 6: Time of Occupancy (Dwell Time) (101 Pulses in 10 Seconds)

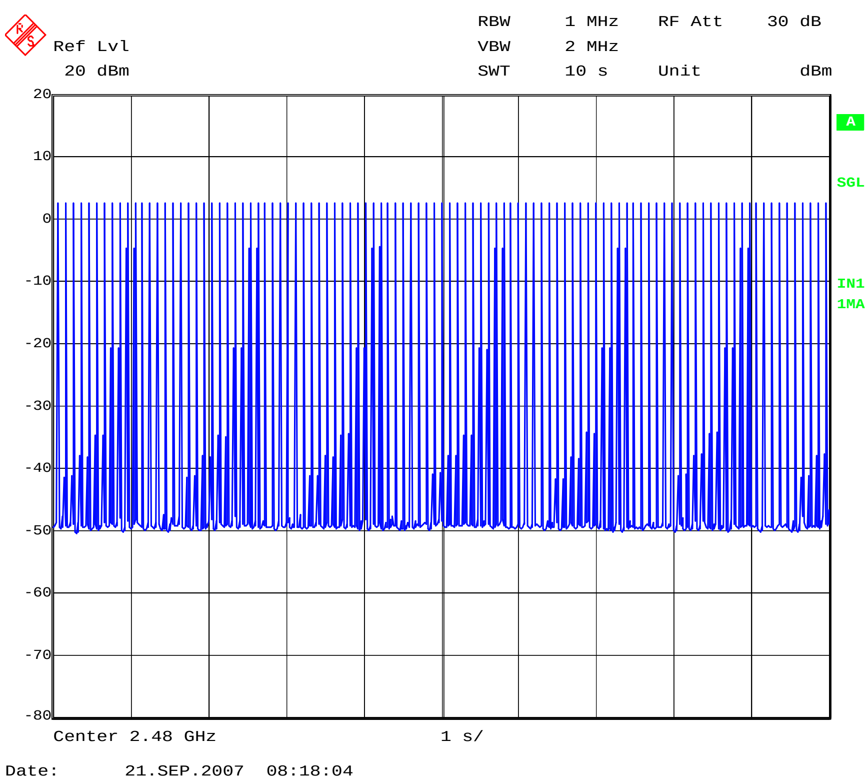


Figure 7: Time of Occupancy (Dwell Time)

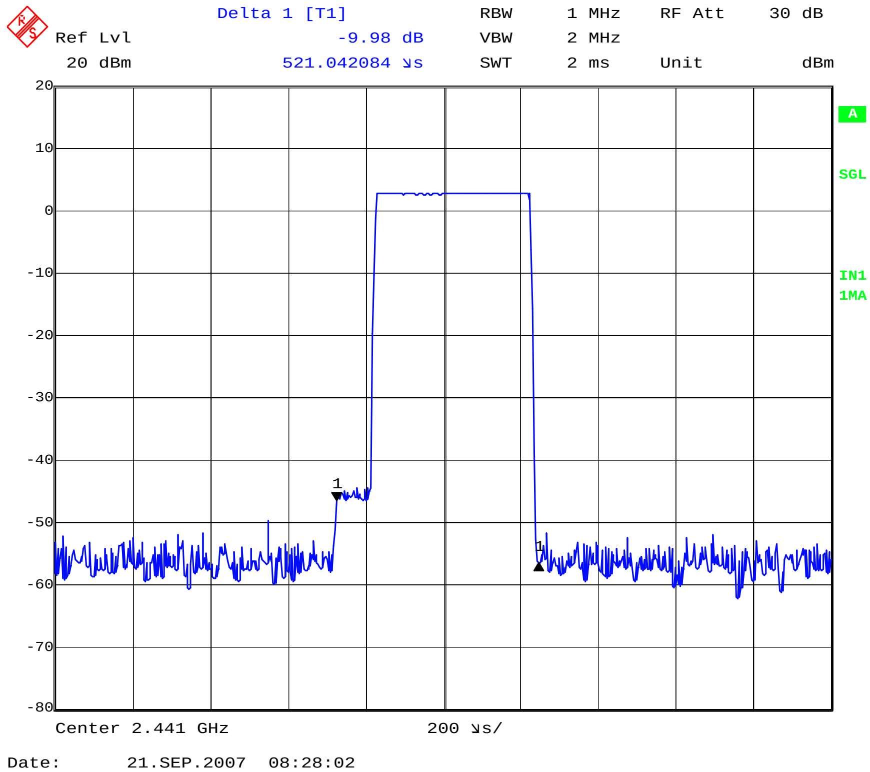



Figure 8: Time of Occupancy (Dwell Time)

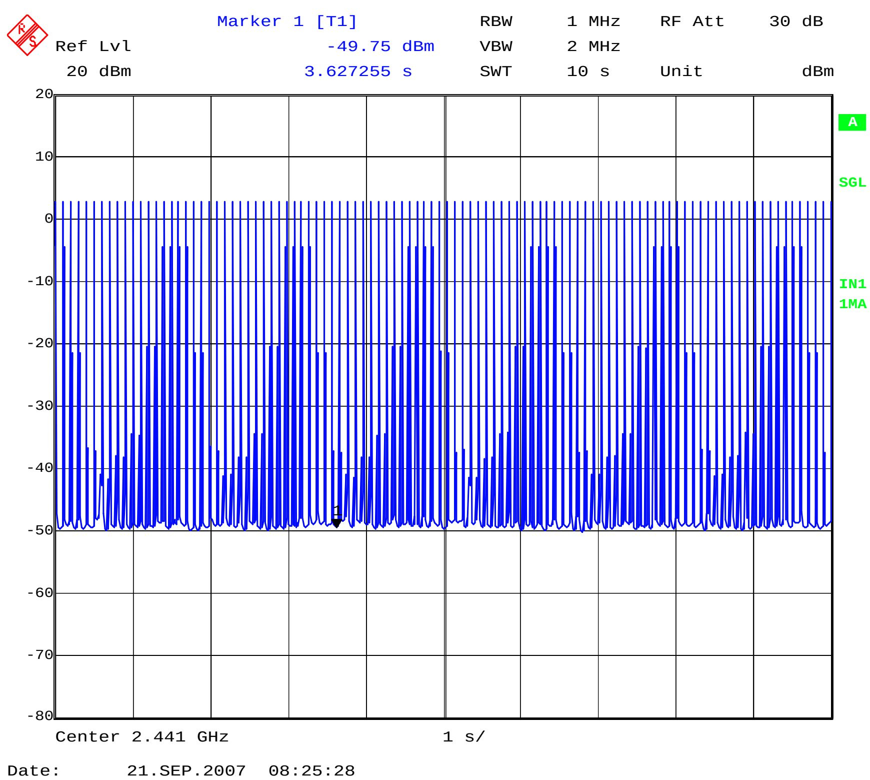


Figure 9: Time of Occupancy (Dwell Time)

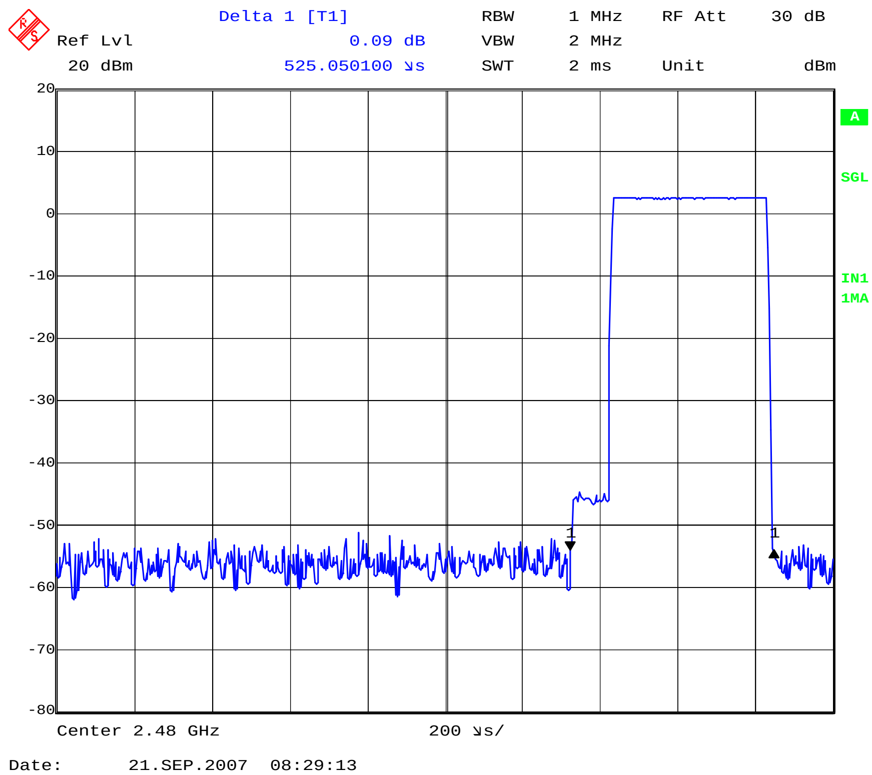
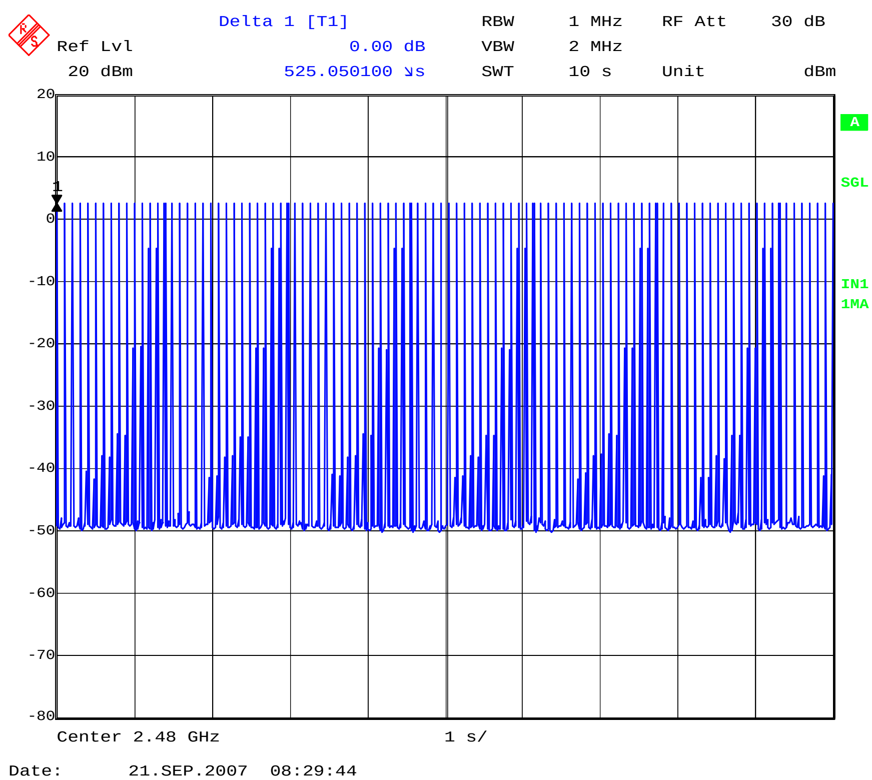



Figure 10: Time of Occupancy (Dwell Time)



# 7 20DB BANDWIDTH

## 7.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = 2 to 3 times the 20dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20dB span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The EUT was made to transmit at its maximum data rate. The analyzer trace was allowed to stabilize and the marker to peak function was used to set the marker to the peak of the emission. The marker delta function was used to measure 20dB down one side of the emission. The marker delta function was reset and marker 2 was moved to the other side of the emission until it was even with the reference marker. The marker delta reading at this point was recorded as the 20dB bandwidth. This test was performed using an un-modulated signal and with a modulated signal.

## 7.2 Test Results

The graph below illustrates that the maximum 20dB bandwidth is 866kHz.

Figure 11: 20dB Bandwidth (Low Channel) = 865.7kHz

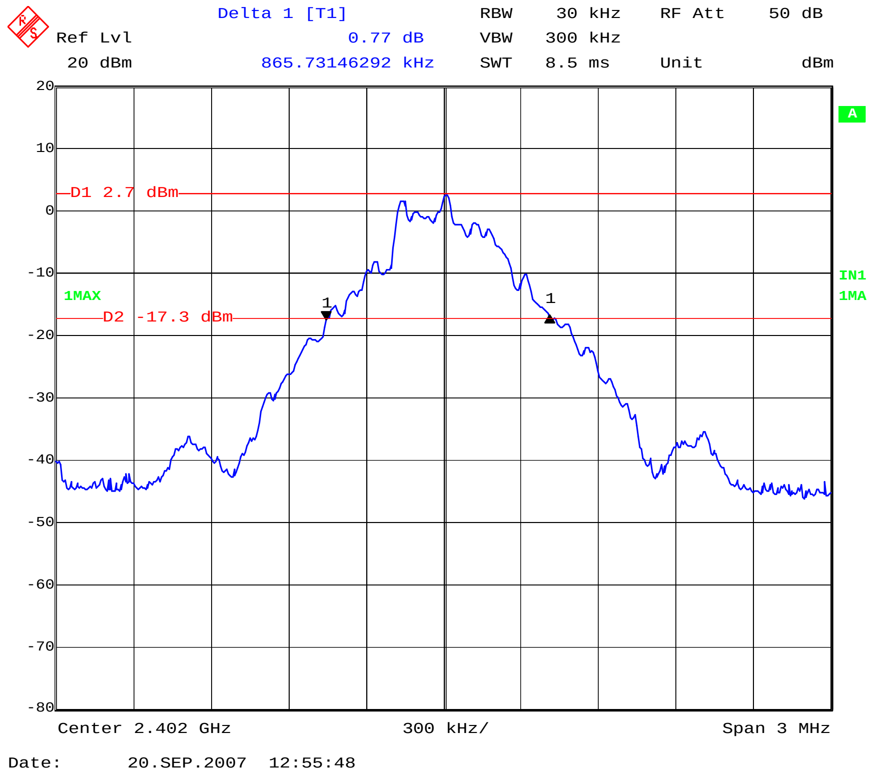



Figure 12: 20dB Bandwidth (Mid Channel) = 866kHz

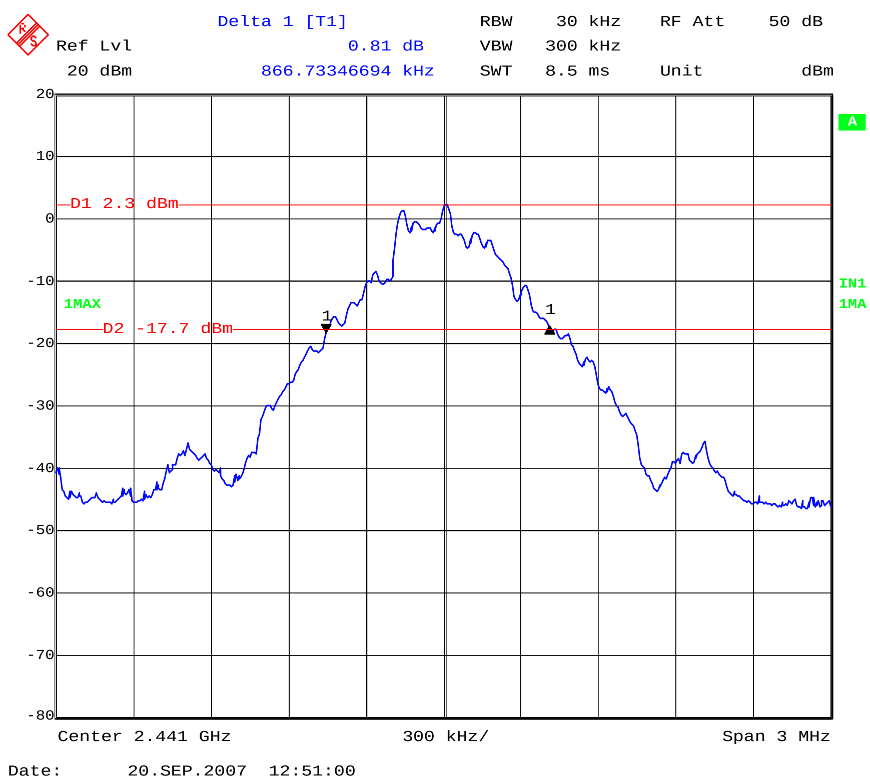
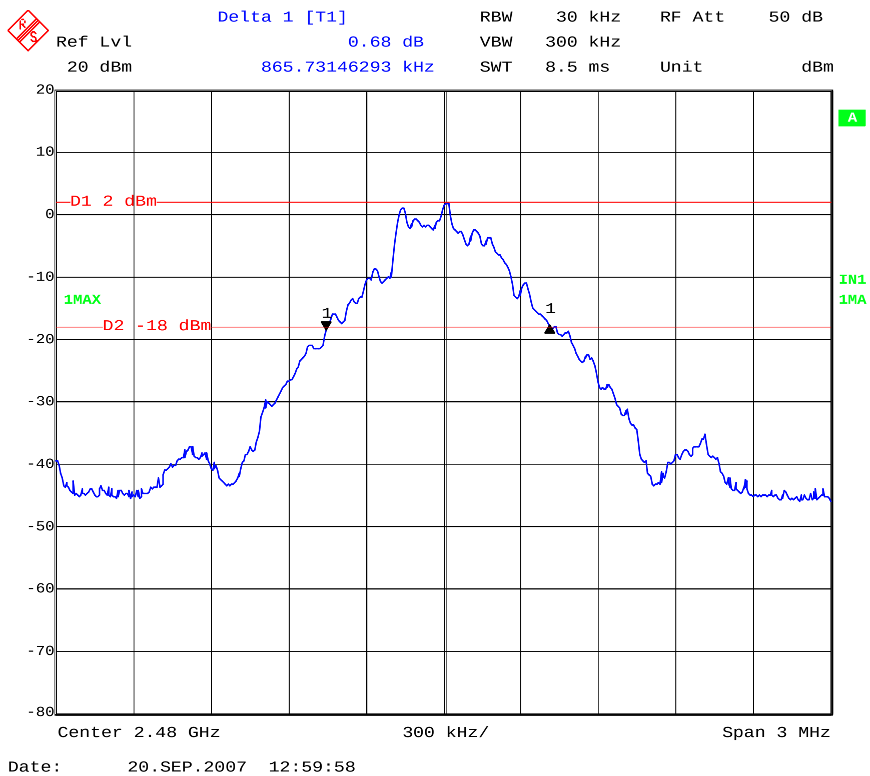


Figure 13: 20dB Bandwidth (High Channel) = 865.7 kHz



# 8 CONDUCTED OUTPUT POWER

## 8.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The mareker to peak function was used to measure the peak output power. The following spectrum analyzer settings were used:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

## 8.2 Limits

The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

## 8.3 Test Results

The data below illustrates that the maximum conducted RF output is 3.14dBm.

Figure 14: Conducted Output Power (Low Channel) = 3.14dBm

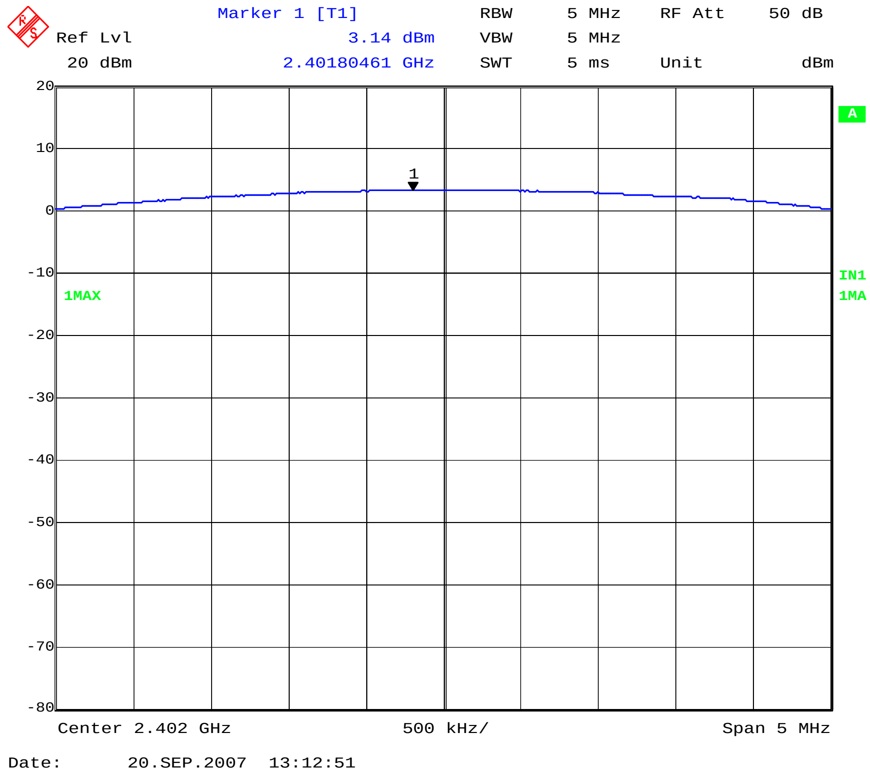



Figure 15: Conducted Output Power (Mid Channel) = 2.76dBm

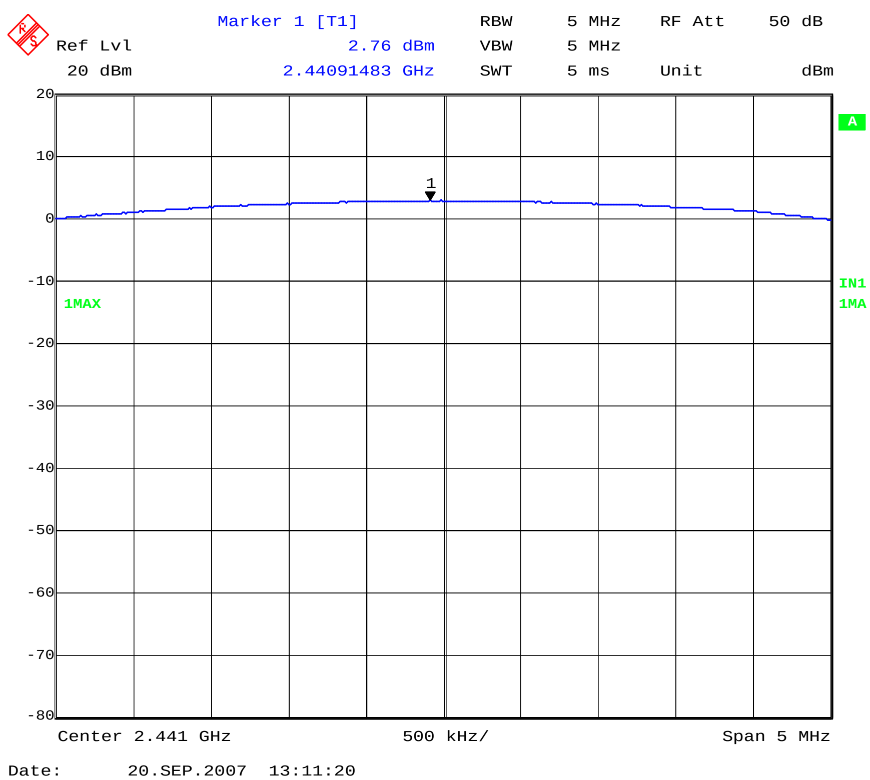
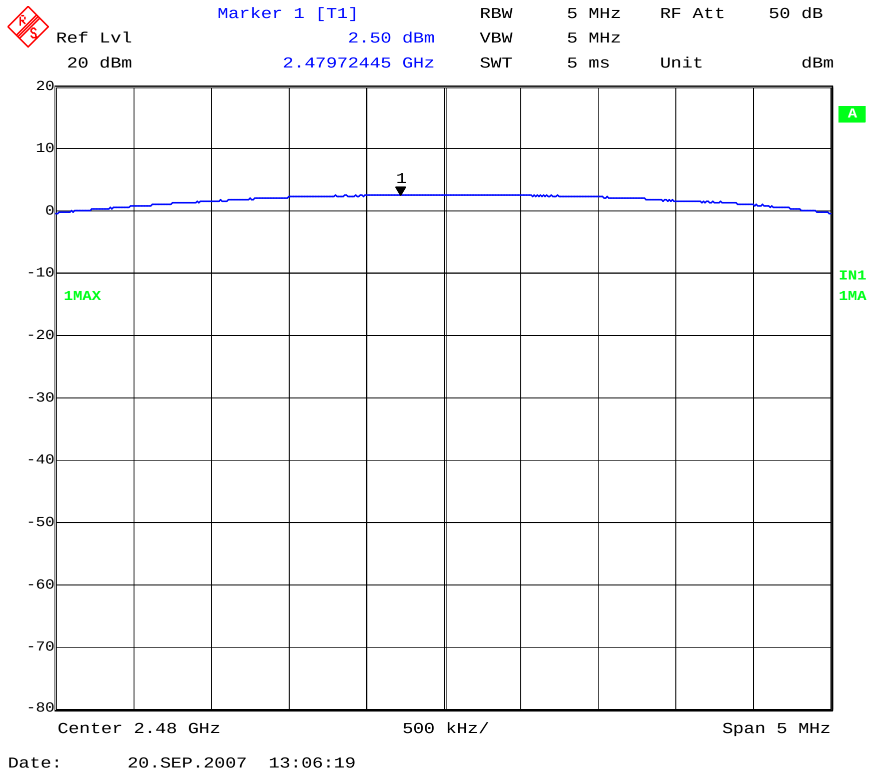


Figure 16: Conducted Output Power (High Channel) = 2.5dBm



# 9 BAND EDGE MEASUREMENTS

## 9.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep Time = Auto

Detector Function = Peak

Trace Type = Max Hold

The trace was allowed to stabilize and the marker was set on the emission at the band edge or highest modulation product outside of the band (if this level was higher than that at the band edge). The marker measurements for the high band edge were performed as outlined in the FCC measurement procedures DA 00-705 released on March 30, 2000. The low band edge measurements were performed by classical methods.

## 9.2 Test Results

The graphs and calculations below illustrate that the band edge requirements are met. The marker delta method was used for the high band edge. For the low band edge display lines were placed on the graphs to illustrate that the field strength at the band edge frequencies were below the average and peak limits.

| **Step 1** | |
|---|---|
| Fund. Field Strength | Det. |
| 93.73 | Peak |
| 64.32 | Average |

| **Step 2** | | | | |
|---|---|---|---|---|
| Fund(dBuV/m) | Freqs. | Reading (dBuV/m) | **Delta** | |
| 93.68 | 2483.5MHz | 56.62 | **37.06** | Single Carrier |
| | 2483.9MHz | 58.46 | **35.22** | Single Carrier |
| | 2484.5MHz | 58.63 | **35.05** | Single Carrier |
| | | | | |
| | 2483.5MHz | 55.92 | **37.76** | Hopping |

| **Step 3** | | |
|---|---|---|
| B.E. Frequencies | Peak B.E. Field Strengths (dBuV/m) | Avg. B.E. Field Strengths (dBuV/m) |
| 2483.5MHz | 56.67 | 27.26 |
| 2483.9MHz | 58.51 | 29.1 |
| 2484.5MHz | 58.68 | 29.27 |
| | | |
| 2483.5MHz | 55.97 | 26.56 |

Figure 17: Peak In-Band Field Strength Measurement (93.73dBuV/m)

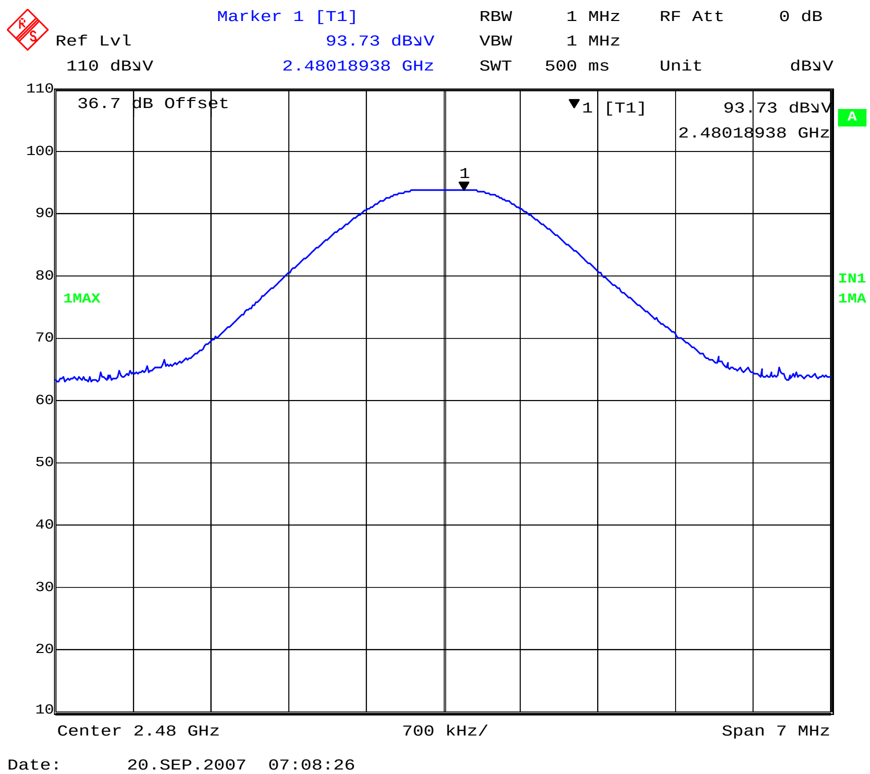



Figure 18: Average In-Band Field Strength Measurement (64.32dBuV/m)

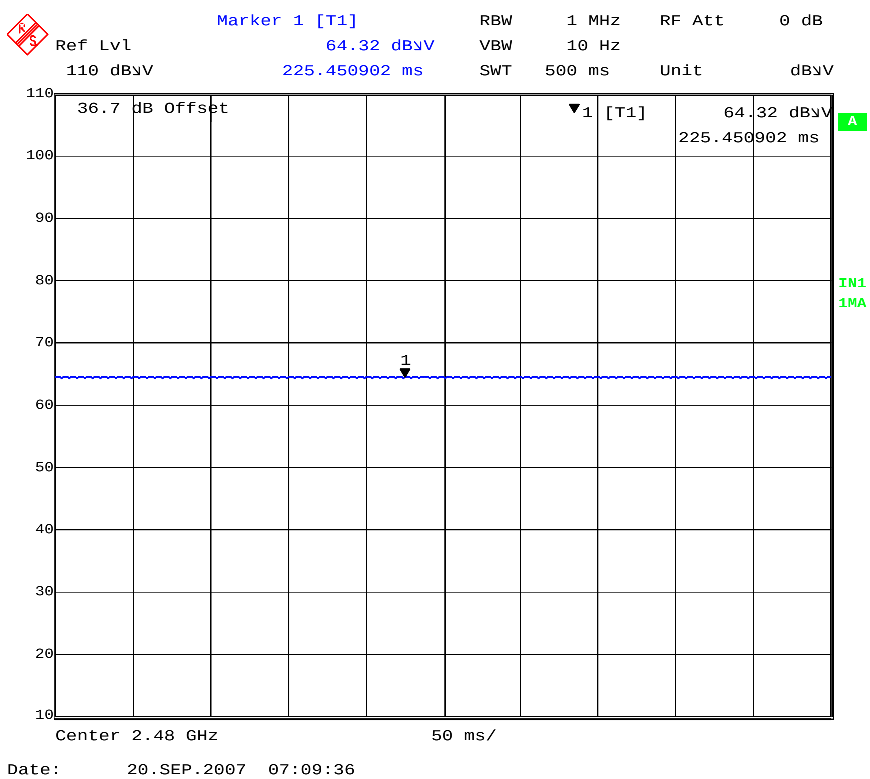
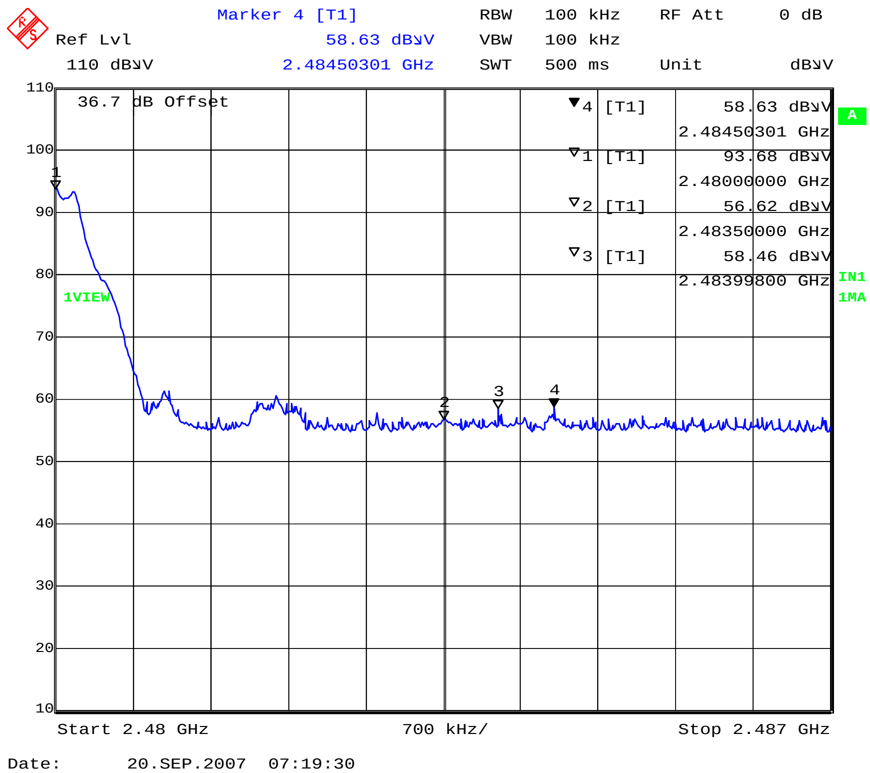


Figure 19: High Band Edge – Single Carrier




Peak Fund: 93.68 dBuV/m

2483.5MHz: 56.62

2483.9MHz: 58.46

2484.5MHz: 58.63

Figure 20: High Band Edge – Hopping Enabled


2483.5MHz: 55.92dBuV/m

Figure 21: Low Band Edge – Peak Detection

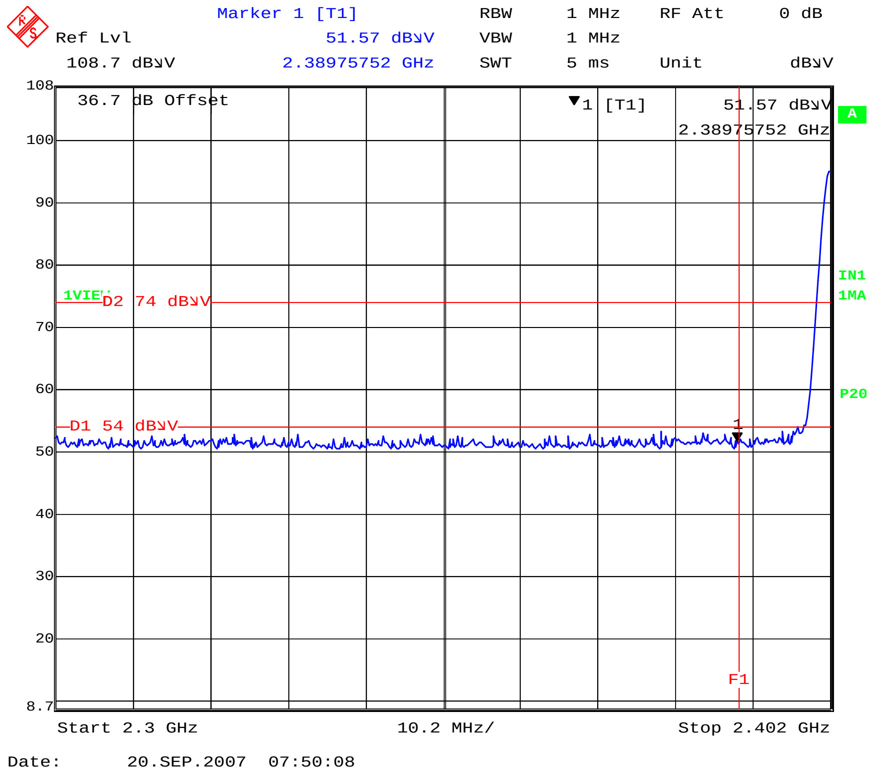
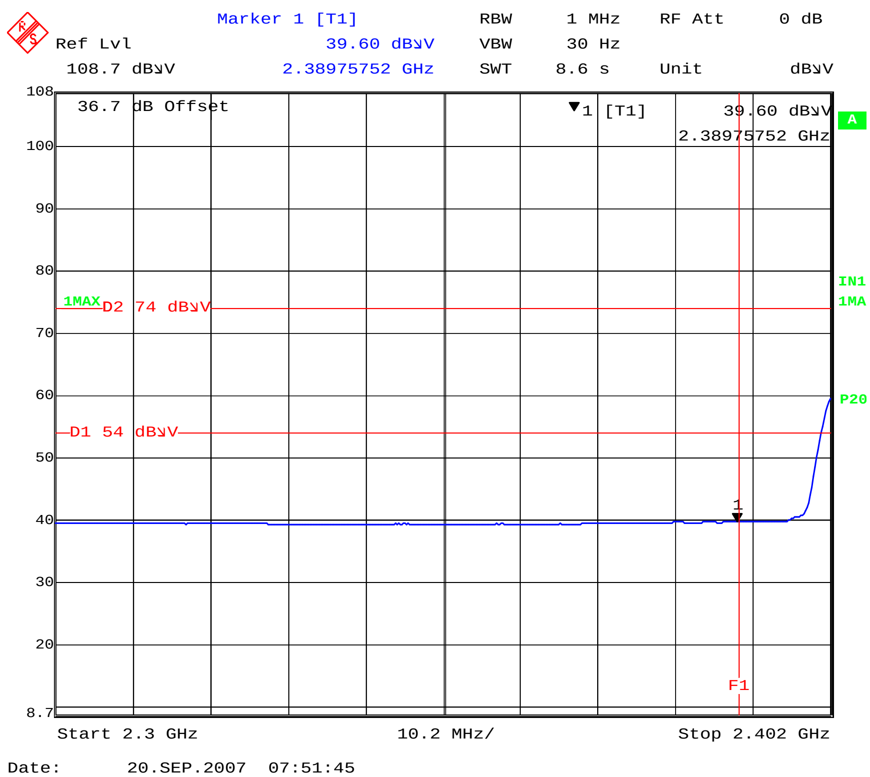



Figure 22: Low Band Edge – Average Detection



# 10 CONDUCTED SPURIOUS EMISSIONS

## 10.1 Test Procedure

The antenna port of the G800E0AUAL was directly connected to the input of a spectrum analyzer through a specialized RF connector and an attenuator. The spectrum analyzer was offset by an appropriate amount to compensate for the attenuator and the associated cable loss. The hopping function of the G800E0AUAL was enabled. The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (harmonics) from the lowest frequency generated in the EUT through the $10^{th}$ harmonic. This was accomplished using software to perform multiple scans and then plot all of the scans on the same graph.

RBW = 100kHz

VBW $\geq$ RBW

Sweep Time = Auto

Detector Function = Peak

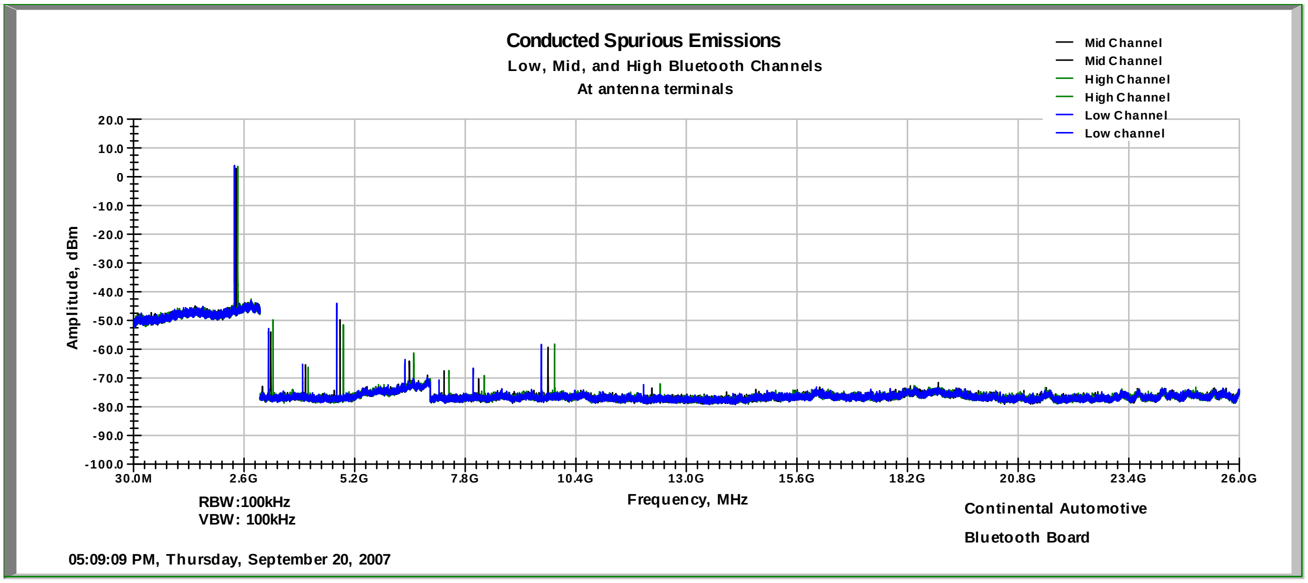
Trace Type = Max Hold

The level of each spurious emission was compared with the appropriate limit.

## 10.2 Test Results

The graph below illustrate that the conducted spurious emissions were all at least 20dB below the in-band conducted power.

Figure 23: Out of band emissions at antenna terminals



# 11 FIELD STRENGTH OF SPURIOUS RADIATION (TRANSMITTING)

## 11.1 Test Procedure

The measurement guidelines from ANSI C63.4-2003 were followed. The G800E0AUAL was placed on a non-conductive turntable. It was then set to transmit at its highest output power level and with the modulation scheme that produced the highest conducted output power level. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The measurement was then performed with an average detector and corrected for antenna factor and cable loss.

## 11.2 Test Results

The G800E0AUAL met the field strength of spurious radiation requirements of FCC §15.209 and §15.247(c). All spurious emissions were attenuated below the level of the carrier by at least 20dB. All emissions falling in the restricted bands from §15.205 were maximized and are reported in Table 3 below.

Table 3: Radiated Spurious Emission Measurements

| TX Channel | Frequency | Polarity (H/V) | Cab. Loss Including Preamp Gain (dB) | Ant. Factor(dB) | Corr. Reading. (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Detector | Results |
|---|---|---|---|---|---|---|---|---|---|
| Low | 3.202 GHz | V | -34.07 | 30.88 | 45.71 | 74 | -28.29 | Peak | **Compliant** |
| Low | 4.804 GHz | V | -31.92 | 32.95 | 59.3 | 74 | -14.7 | Peak | **Compliant** |
| Low | 3.202 GHz | V | -34.07 | 30.88 | 24.97 | 54 | -29.03 | Avg. | **Compliant** |
| Low | 4.804 GHz | V | -31.92 | 32.95 | 40.51 | 54 | -13.49 | Avg. | **Compliant** |
| Low | 3.2023 GHz | H | -34.07 | 30.85 | 42 | 74 | -32 | Peak | **Compliant** |
| Low | 4.804 GHz | H | -31.92 | 33.23 | 64.52 | 74 | -9.48 | Peak | **Compliant** |
| Low | 3.2023 GHz | H | -34.07 | 30.85 | 23.41 | 54 | -30.59 | Avg. | **Compliant** |
| Low | 4.804 GHz | H | -31.92 | 33.23 | 45 | 54 | -9 | Avg. | **Compliant** |
| Mid | 4.882 GHz | V | -31.45 | 33.09 | 59.13 | 74 | -14.87 | Peak | **Compliant** |
| Mid | 4.882 GHz | V | -31.45 | 33.09 | 38.62 | 54 | -15.38 | Avg. | **Compliant** |
| Mid | 4.8816 GHz | H | -31.44 | 33.33 | 61.59 | 74 | -12.41 | Peak | **Compliant** |
| Mid | 4.8816 GHz | H | -31.44 | 33.33 | 43.14 | 54 | -10.86 | Avg. | **Compliant** |
| High | 4.9601 GHz | V | -31.15 | 33.23 | 54.42 | 74 | -19.58 | Peak | **Compliant** |
| High | 4.9601 GHz | V | -31.15 | 33.23 | 45.37 | 54 | -8.63 | Avg. | **Compliant** |
| High | 4.96 GHz | H | -31.15 | 33.44 | 64.54 | 74 | -9.46 | Peak | **Compliant** |
| High | 4.96 GHz | H | -31.15 | 33.44 | 45.28 | 54 | -8.72 | Avg. | **Compliant** |

# 12 FIELD STRENGTH OF SPURIOUS RADIATION (RECEIVING)

## 12.1 Test Procedure

Measurements are made over the frequency range of 30 MHz to five times the highest frequency operating within the device. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole. From 30 to 1000 MHz, a quasi-peak detector was used for measurement. Above 1000 MHz, average measurements were performed.

Measurements of the radiated field are made with the antenna located at a distance of 3 meters from the EUT. If the field-strength measurements at 3m cannot be made because of high ambient noise level or for other reasons, measurements may be made at a closer distance, for example 1m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4.

## 12.2 Test Results

The G800E0AUAL is **compliant** with the radiated disturbance requirements of FCC §15.109 for a class B device.

Figure 24: Receive Mode Spurious Emissions

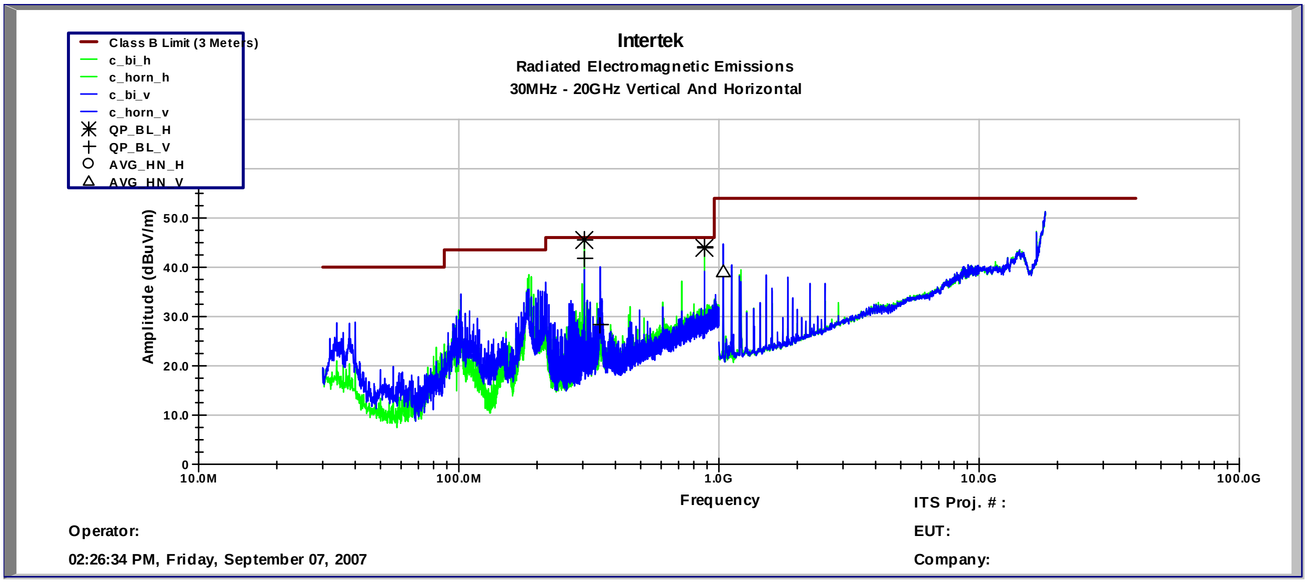



Figure 12-25 FCC §15.109 Maximized Radiated Emissions

| Frequency (MHz) | Polarity (H/V) | Reading (dBuV) | Cab. (dB) | Ant. (dB) | Corr. Reading. (dBuV/m) | Limit (dBuV/m) | Delta (dB) | Detector | Results |
|---|---|---|---|---|---|---|---|---|---|
| 304.0 MHz | H | 28.69 | 2.41 | 14.42 | 45.52 | 46.02 | -0.5 | QP | **Compliant** |
| 880.06 MHz | V | 18.07 | 4.27 | 21.8 | 44.14 | 46.02 | -1.88 | QP | **Compliant** |
| 880.07 MHz | H | 16.95 | 4.27 | 22.7 | 43.92 | 46.02 | -2.1 | QP | **Compliant** |
| 304.0 MHz | V | 25.51 | 2.41 | 13.88 | 41.8 | 46.02 | -4.22 | QP | **Compliant** |
| 186 MHz | H | 26.04 | 1.8 | 10.6 | 38.44 | 43.52 | -5.08 | PK | **Compliant** |
| 349.0 MHz | V | 10.48 | 2.6 | 15.26 | 28.34 | 46.02 | -17.68 | QP | **Compliant** |